magnetfabrik bonn

# Applications Brief

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## New solutions to new challenges – Magnets for stray field-immune angle measurement based on the differential principle

**Due to the high currents involved, electric motors and circuits in hybrid and electric vehicles generate magnetic fields which affect the accuracy of magnetic field sensors. Sensors which measure on the basis of differential principles can reduce or eliminate this problem. However, they require sensor magnets which are adapted to the measuring principle. The requirements, in particular with regard to the field gradients and installation space for sensor magnets, are confronting magnet manufacturers with new challenges. Magnetfabrik Bonn GmbH has developed an economical polymer-bonded hard ferrite magnet which optimally fulfills the sensor-related requirements due to a special configuration of the 4-pole magnetization.**

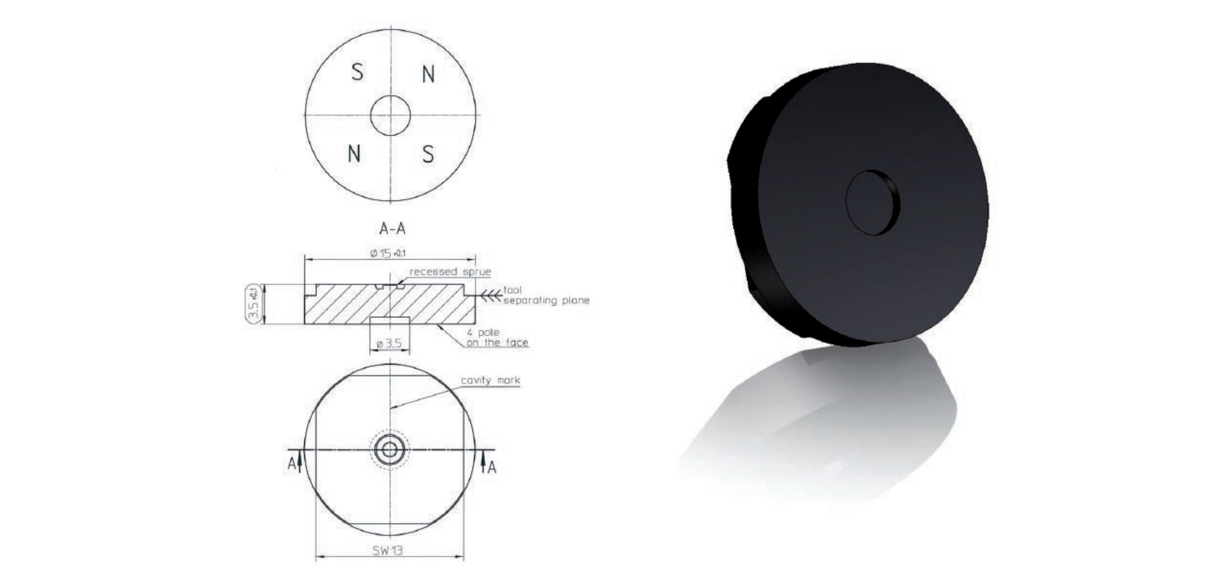


Fig. 1: Four-pole magnet for angle measuring sensors using the differential principle

Permanent magnets and magnetic field sensors are used as measuring systems in many applications. They detect linear and rotary movements in cars, machinery and domestic appliances reliably and precisely. Due to their high level of vertical integration and economic efficiency, field sensors, which usually make use of the Hall effect, are used for many applications in the automobile electronics and industrial electronics industries. The measuring systems operate contact-free and are therefore not subject to wear. Alongside the Hall effect switches and linear field sensors, field sensors with vector-based field detection and a two-dimensional arrangement of sensor elements have continuously been growing in importance in recent years. Nowadays, extremely precise sensor systems are required for the complex control units that guarantee the functionality and safety of modern cars. In most cases, it is also necessary to meet additional requirements in terms of resistance to the magnetic stray fields that arise in modern electric automotive drives.

Sensor manufacturers such as TDK and Melexis have launched new sensors based on the Hall effect. These use a very flexible architecture to suppress the stray fields that impinge upon the fields of the angle sensor magnets. In this way, they guarantee stray field immunity as set out in ISO 11452-8 as well as in the individual OEM-specific requirements.

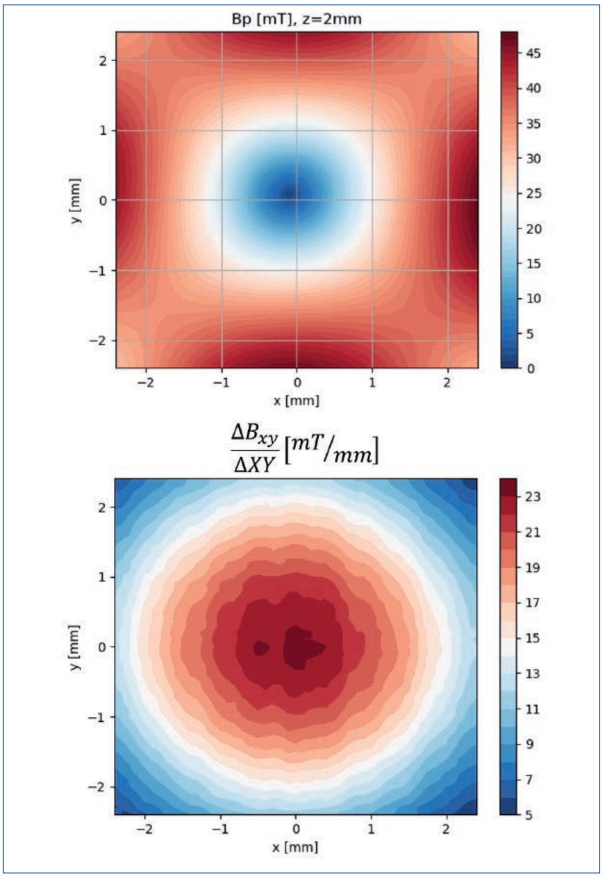


Fig. 2: a) Planar field strength in the plane at a distance of 2 mm.
b) Field gradients in the plane as described for MLX90371.

A four-pole magnet is used and, in end-of-shaft measurements, this controls the sensor, which itself operates on the basis of the differential principle. The Melexis sensor MLX90371 requires a high field gradient at the center axis in order to achieve optimum angular resolution. To achieve this, Magnetfabrik Bonn GmbH developed magnet 69.596 based on the use of a polymer-bonded hard ferrite. This meets the requirements in terms of the field strength and field gradients for the "low-field" variant of the Melexis sensor (see Fig. 2).

In the Melexis sensor, the sensor magnet has been designed in such a way that a value of 25 mT is not exceeded at a distance of 2 mm and with a radius of 1 mm. The magnet is also suitable for sensors that evaluate the axial field strength over larger radii. Such as, for example, sensors manufactured by TDK. Fig. 3 shows the dependence of the vertical field strength plotted against the distance as well as the field strength in the plane 2 mm above the magnet.
At the larger distance to the front face of the magnet, the scaling of the field strength and gradient is as shown in Fig. 3.

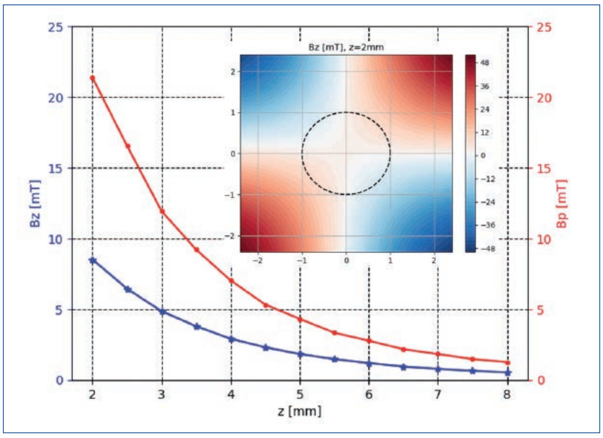


Fig. 3: Field decay plotted against distance z at a radius of 1 mm and, in the insert: axial field strength in the plane 2 mm above the front face of the magnet.

## The precision and safety many industries and sectors demand

The chosen magnetic material, a hard ferrite in a PA6 matrix, is suitable for applications up to 160 °C. Depending on the application, the material can be adapted and the magnetic principle can be transferred to a magnet that has been injected onto or into a carrier. The sensor magnet can be used in a large number of applications. In industrial environments, for example, it is suitable for valve actuators and rotary drives. In the automotive industry, it has potential applications in the field of actuators for exhaust gas recirculation systems and turbochargers, as well as in systems for detecting the position of pedals, steering wheel, chassis orientation and gear actuators or for gearshift detection.

We would be delighted to work with you to design a magnet solution specially tailored for your application.

**Sharing the same goal. Put us to the test.**

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